to be about the same as for that excited from air. Half of it was absorbed in two layers of aluminium foil 0.00038 centimeters thick.

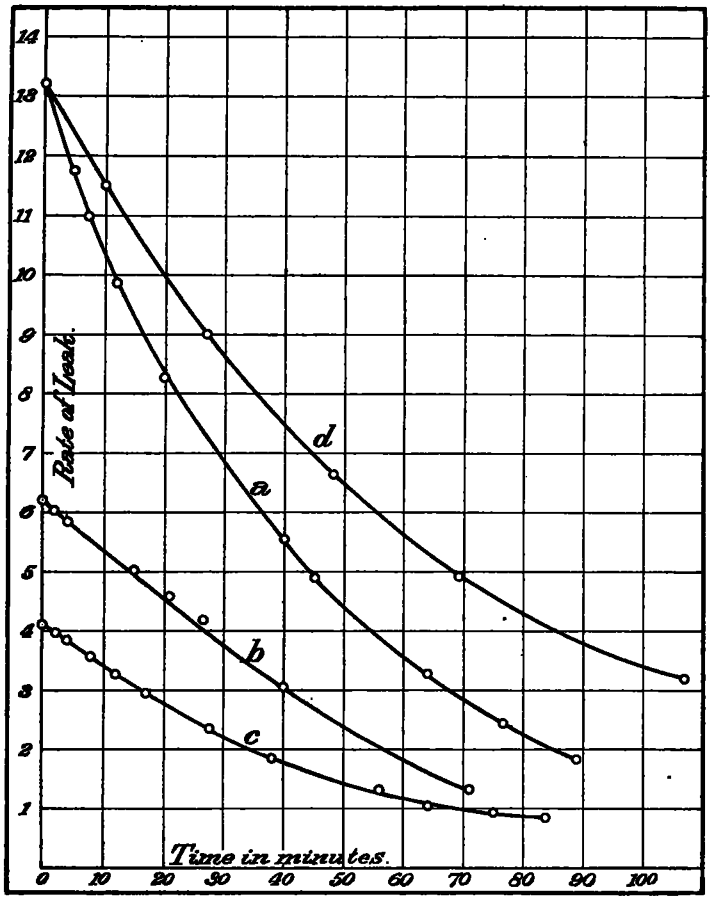

FIG. 1.

This radioactivity could be transferred by rubbing from the surface of the tin vessel on to leather or cotton, etc., moistened in ammonia. When the cotton thus treated was burnt to ashes the residue was still radioactive. Heating to a bright red heat destroyed only a very little of the radioactivity.

It was found that during a snowstorm the amount of radioactivity present kept quite constant so long as the fall of snow remained the same; twenty-four hours after the fall had ceased only a trace of radioactivity could be obtained. The amount of radioactivity obtained on the best day from a liter of snow was about equal in effect to one-fifth of a gram of uranium. It might be of interest to calculate the amount that could be obtained on such a day from one square mile of snow covered territory one centimeter thick. Taking 20 divisions per second as the amount obtained from a liter, we would get about 5×10^8 divisions per second. One scale division with this apparatus corresponds roughly to an ionization current of 3×10^{-13} amperes per second. Therefore a square mile ought to give something of the order of 1.5×10^{-4} amperes per second. This is an amount which could easily be measured by a galvanometer. Over the whole territory of Canada when it is snowing a considerable amount of energy is being radiated. From these results two conclusions may be drawn, either that this radioactivity is different from that excited from air, or that the excited air is a much more complicated substance than was at first supposed. There may be several processes going on, and this may be one of them. Each process may have different rates of formation and decay, and each radioactivity be the superposition of one or more of the processes. Recent experiments by the author rather support this latter view. These points are under investigation and will form the subject of a future paper. It seems beyond doubt that there is a radioactive substance in the atmosphere; how produced, at present, is not known. The falling snow acts as a sort of filter for it and tends to remove portions of it from the atmosphere.

This subject seems to me to be of great importance and interest, and future investigations along this line may greatly extend our knowledge of the physics of the atmosphere.

NOTES AND EXTRACTS.

METEOROLOGY AT THE AMERICAN ASSOCIATION.

At the meeting of the American Association for the Advancement of Science and its affiliated societies held at Washington, January 3–10, 1903, a number of papers were read which, judging from their titles, should have some bearing upon meteorological problems. We make the following selection of authors and titles and hope that in some cases we may be able to print the papers themselves:

S. P. Langley. The solar constant and related problems.

E. O. Lovett. Special periodic solution of *n* bodies. On the integrals of the problem of *n* bodies.

A. S. Mitchell. The new gases neon, krypton, and zenon in the chromosphere.

S. R. Cook. (Case School.) On the distribution of pressure around spheres moving with constant velocity in a viscous fluid.

H. W. Springsteen. (Case School.) On the thermal conductivity of glass.

A. L. Rotch. Atmospheric circulation near the equator.

Edwin H. Hall. (Harvard University.) Is there a southerly deviation of falling bodies ?

J. R. Benton. (Washington, D. C.) Elasticity of copper and steel at — 186° C.

J. R. Benton. (Washington, D. C.) Experiments in connection with friction between solids and liquids.

J. S. Shearer. (Cornell University.) The heat of vaporization of oxygen and nitrogen.

E. Rutherford and H. L. Cook. (McGill University.) A penetrating radiation from the earth's surface.

S. J. Allen. (McGill University.) Radio-activity of freshly fallen snow.

Carl Barus. (Brown University.) The excessive nucleation of the atmosphere.

Carl Barus. (Brown University.) Certain data bearing on the occurrence of lightning.

Carl Barus. (Brown University.) The electrical charges of water nucleii.

A. F. Zahm. Theory, construction, and use of a pressure tube anemometer.

H. Parker Willis. (Washington, D. C.) Requisites in crop reporting.

Prof. Willis L. Moore. Economic work of the Department of Agriculture, especially of the Weather Bureau.

Edwin G. Dexter. The psychology of weather influence.

A. H. Pierce. The apparent form of the heavens and the illusory enlargement of heavenly bodies at the horizon.

T. C. Chamberlin, William H. Welch, and others. How can endowments be used most effectually for scientific research ?

Stanley Coulter. (Purdue University.) The changes of fifty years in a local flora.

C. Abbe. Observations on the cause of the rollers and double rollers at the island of Ascension.

E. F. Nichols and G. F. Hull. The pressure due to radiation.

R. W. Wood. Screens transparent only to ultraviolet light.

L. R. Jones and A. W. Edson. Pressure and flow of sap in the sugar maple.

H. C. Cowles. The relative importance of edaphic and climatic factors in determining the vegetation of mountains with especial reference to Mount Katahdin.

D. T. MacDougall. Plant growth as effected by light and darkness.

Peter Fireman. (Washington, D. C.) Motion of translation of a gas in a vacuum.

THE BECQUEREL RAYS IN METEOROLOGY.

In Harper's Monthly Magazine for January, 1903, Prof. J. J. Thomson has a short and suggestive article on the Becquerel rays, in continuation of his preceding article on Cathode rays in Harper's for September, 1901. These articles are easily accessible to American readers, but we summarize them in connection with Thomson's extended memoir, pp. 25–73, of Vol. IV of the New Volumes, or 10th edition, of the Encyclopedia Britannica, published in October, 1902. The eminent author brings out very clearly the fact that many substances have the power of radiating other kinds of rays than those that cause the phenomena of light and heat. It was long known that just as some bodies by being heated sufficiently give out light and are said to be red hot or white hot, so other bodies when illuminated sufficiently by the sun's rays, or by an electric light, give out the light that is known as phosphorescence. Thus uranium salts when exposed to sunlight for a short time and then removed into a dark room will continue to glow with a pale light for a long time. This was styled phosphorescence because the glow has very much the appearance of the light given out by phosphorus in the air; but the glow of phosphorus is due to the slow oxidation of that substance, whereas the glow of uranium salts appear to be a purely mechanical process like the long-continued ring of a bell after it has been struck. The phosphorescence from uranium has a feeble photographic power, but it continues for a long time and by long exposure will produce excellent pictures. It was formerly supposed that a previous exposure to sunlight is essential in order to produce the phosphorescnce of uranium, but Becquerel was able to show that salts of uranium crystallized in the dark and never exposed to any bright light emitted the same radiation, as though this power were a property inherent to uranium itself.

These Becquerel rays from uranium are, in fact, a mixture of Roentgen rays and cathode rays. The former which Professor Rutherford called the alpha rays, were found by him to be easily stopped by thin layers of paper or aluminum, while the cathode or beta rays can penetrate aluminum, so that when they have once been generated inside of a vacuum by electric discharge, they can pass through an aluminum window into the air outside; they are also deflected by the action of a magnet, as shown by Becquerel. The cathode rays of the electric discharge have been investigated by Prof. J. J. Thomson, who showed that they consist of exceedingly small particles, much smaller than an ordinary molecule or chemical atom, charged with negative electricity and moving at the rate of many thousand miles per second; their velocity depends upon the perfection of the vacuum in which the electric discharge takes place. The highest recorded velocity of the cathode rays from the electric discharge in a vacuum is about 70,000 miles per second, but the cathode rays given out by uranium spontaneously have a still greater velocity.

Another substance having the same peculiar power of emission is thorium, which phosphoresces so perfectly that it can be used in the manufacture of the incandescent mantels of the Welsbach and other lights. Any natural mineral containing even a small percentage of uranium was found by Monsieur and Madame Curie to possess the power of phosphorescence and some minerals seem to have it in a remarkable degree, as though some powerful radiator were present. Finally, these investigators were able to extract from pitch blende a very remarkable substance, namely, polonium, which was associated with bismuth. Subsequently M. Bement extracted radium, which was associated with barium, and finally Debierne obtained a third substance which he called actinium.

We have, therefore, radiations from the ordinary minerals, uranium, thorium, and pitch blende and also from the special substances radium, polonium, and actinium extracted from pitch blende. Radium has become famous through the great perseverance and skill of Monsieur Curie and Madame Curie, his wife, in purifying it and investigating its properties. In its purest condition it exceeds uranium an hundred thousand fold in its radioactivity. The velocities of the rays emitted by it have been recorded as 120,000 miles per second instead of the 70,000 attributed to uranium; the total loss of mass is exceedingly small, the loss of energy in one year is only large enough to melt a layer of ice of the same area as the radium and 0.02 of an inch thick. The radium is self luminous, shining with a bluish light; it, like the Roentgen rays, makes a sensitive screen phosphoresce; it shows the bones in the hand, and is so vigorous that it has produced sores on those who have incautiously carried it about their persons. The radium emits negatively electrified particles with a velocity in some cases approaching that of light. This continued emission of particles from the radium, of course implies that the radium is losing mass and energy. As this loss of energy goes on continuously the questions arise what is its nature? And how is it stored away? Becquerel was able to transfer the radioactivity from uranium to barium. Rutherford, of McGill University, separated two substances from thorium, one an inert body and the other very active, which after a few days had entirely interchanged their properties, the active becoming inert and vice versa; the time taken by the active body in losing one-half of its activity was equal to the time required by the inert body in regaining one-half of its activity. There is, therefore, an active form of thorium and an inactive form. It is possible that there may be also analogous active and inactive forms of radium. The active form of thorium not only gives out Roentgen and cathode rays, but also a radioactive gas whose activity lasts only for a few minutes and when this gas becomes inert it resembles the new gases argon and helium. Radium also gives out a radioactive gas and its activity lasts much longer than that from thorium. These radioactive gases, or emanations, possess the remarkable property of making almost any substance with which they come in contact also radioactive. A piece of paper can be made as strongly active as a piece of metal. The induced radioactivity is very much increased if the substance is negatively electrified while being acted on by the emanation.

Elster and Geitel have shown that substances may be made radioactive without the aid of the emanations from thorium or radium; it is only necessary to hang them up in the open air, insulate them, and charge them strongly with negative electricity. As the earth itself is negatively electrified, it follows that all pointed conductors connected with the earth and discharging negative electricity into the air become radioactive. Thus, lightning conductors, the pointed leaves and spines of trees, and even freshly fallen rain or snow are always radioactive. The process by which they attain this property is explained by Prof. J. J. Thomson as due to the fact that positively electrified ions accumulate close to the surface of the body, forming a layer of positive electricity around it. This pulls the negative electricity from the interior of the body so that it shoots out with great velocity. But negative electricity moving with great velocity is the same thing as cathode rays, and if a body gives out cathode rays it is radioactive. Thus, it happens that cathode rays are probably emanating from all points of the earth's surface.

This last conclusion stands in intimate relation to numerous phenomena of meteorology and agriculture. The electrical discharges from hilltops and mountains are often exceedingly severe. The observers of the United States Coast and Geodetic Survey and of the Weather Bureau have sometimes been frightened from their mountain stations by the brilliant, and apparently dangerous, long-continued discharges of negative electricity. The rapidity with which rainfall evaporates from mountain peaks has often been attributed, in a general way, to the electrification of the mountain mass. The difficulty in raising plants, the stunted tree growth, and the absence of forests have been attributed to some such problematic electric influence. It is quite plausible that the frequency and severity of the electrical phenomena of thunderstorms in mountainous regions may be partly due to the intense discharge of negatively electrified particles into the atmosphere from the highly electrified mountain mass, while of course the rapid currents of rising and falling air are thermodynamic effects.

Other properties of the radiations from radiant matter are fully given by Prof. J. J. Thomson in his article in the Encyclopedia Britannica on the electric discharge through gases.

Gases become conductors of electricity when they are exposed to the Roentgen rays or to the radiation from uranium, thorium, polonium, radium, or actinium, or by the passage through them of cathode rays or Lenard rays, or by exposure to the radiation emitted by electric sparks. * * * A gas exposed to Roentgen rays retains its conductivity for some little time. If, however, it is filtered through a plug of tightly packed glass, wool, or through water, or through metal tubes, or if an electric current be made to traverse it, its conducting power is removed. * * * We regard the conductivity of the gas as due to the presence of positively and negatively electrified particles called ions. * * * An ion after being formed does not last forever, but has a certain duration of life. * * *

The life of an ion in a gas at low pressure is longer than at high pressure, but the velocity of the ion is greater at low pressure. The velocity of the negative ion is almost always larger than that of the positive ion; but if moisture be present in the gas it tends to collect around the ion; it condenses more easily on the negative than on the positive ion, and produces a relatively larger diminution in the velocity of the negative than the positive. When Roentgen rays are passed through moist but dustless air while the air is being expanded, a small expansion and cooling will produce cloudy condensation, but a much larger expansion and cooling will be needed in order to produce cloudy condensation without the assistance of the ions produced by the Roentgen rays. The latter seem, therefore, to act as nuclei favoring the condensation of the vapor.

The sun as the source of our light and heat sends us an intense and complex radiation which doubtless includes the Roentgen and other forms of rays. Sunlight as we get it at the earth's surface is possibly not so rich in these rays as it is at the upper limit of the atmosphere and it does not produce electric conductivity in gases so perfectly as does the radiation from the electric arc light. Elaborate series of observations have rendered it probable that ultraviolet light does not ionize the gas through which it passes until after it has struck the absorbing surfaces between which the electric discharge is taking place, whereas in the case of the cathode and the Lenard rays the gas is ionized at once by the passage through it of the negatively electrified particles moving with great velocity.

It is a plausible hypothesis that sunlight after striking the negatively electrified surface of the earth is reflected and changed in some such manner that the radiation outward from the earth's surface has the power to ionize some of the constituents of the atmosphere and stimulate the condensation of vapor into fog and cloud. Meteorologists therefore must look forward with much interest to further investigations in this field of research.

WEATHER BUREAU MEN AS INSTRUCTORS.

Mr. Ford A. Carpenter, Observer, reports that on December 10, he delivered a lecture on Weather Studies without Instruments before the senior class of the San Diego State Normal School; special reference was made to the clouds and their relation to weather changes.

H. H. MOORE.

Harry H. Moore, voluntary observer for a number of years past, was born in New Haven, Conn., January 15, 1872. At an early age he evinced a mental activity far in excess of his physical strength—a condition remaining with him through life.

Unable to enter into any active business pursuit, he turned to books, music, and nature for recreation, being an extensive reader, a fine pianist and a genuine lover of natural scenery; his love of nature led him into the habit of observing the varying phases of the weather.

The most marked characteristics of his nature were truth and accuracy, subordinating everything, often personal inconvenience, to attain these; this is shown by the careful manner in which his weather reports were prepared, and the punctilious care which characterized all his dealings.

To the casual observer he was quiet and reserved; to those who knew him intimately, a young man of the highest ideals, an exponent of the worthiest sentiments found in humanity, a trusted and loyal friend, whose death occurring in Hartford, Conn., December 8, 1902, leaves no stain, no blemish—only a pure, sweet memory.—*K. G. T.*

CORRIGENDA.

MONTHLY WEATHER REVIEW for July, 1902, page 357, column 1, lines 21 and 22 from bottom, for "several ascensions" read "first ascension;" line 19 from bottom, for "same" read "next."

MONTHLY WEATHER REVIEW for November, 1902, page 525, column 1, line 25, for "1852" read "1872."

THE WEATHER OF THE MONTH.

By W. B. STOCKMAN, Forecast Official, in charge of Division of Records and Meteorological Data.

CHARACTERISTICS OF THE WEATHER FOR DECEMBER.

The mean temperature for the month was generally below the normal, and in appreciable values in the different geographical districts, except in the South Atlantic States, Florida Peninsula, the middle Plateau, and middle and south Pacific districts, where the mean daily departures were slightly in excess.

In the west Gulf States, upper Lake region, North Dakota, middle and southern slope, southern and middle Plateau, and middle and southern Pacific districts there was a slight deficiency in precipitation, the greatest departures — 1.5 inches and — 1.0 inch, occurring, respectively, in the two last-named districts. In the remaining geographical districts the precipitation was above the normal, but the departures were slight, except in New England, the Middle Atlantic States, Ohio Valley and Tennessee, Missouri Valley, and the north Pacific districts, where they ranged from + 1.1 inches to + 2.3 inches.

The relative humidity was normal in the east Gulf States, North Dakota, and the north Pacific districts; slightly below in the South Atlantic States, Florida Peninsula, and the middle and south Pacific districts; elsewhere it was above normal, and markedly so in the northern slope and middle slope regions, where it amounted to + 13 per cent and + 10 per cent, respectively.

The cloudiness was below the average in the Florida Peninsula, North Dakota, and the middle Plateau region; normal in the south Pacific district, and above normal in the remaining geographical districts.

PRESSURE.

The distribution of monthly mean pressure is shown graphically on Chart VI and the numerical values are given in Tables I and VI.

The area of highest mean barometric pressure overlay the Middle Atlantic and Southern States, central valleys, and cen-